



Small Hydro & Ocean Wave Resources

2005 Integrated Energy Policy Report

Workshop

May 9, 2005



Small Hydro



- ◆ *California Definition: On-site installed capacity less than 30MW*
- ◆ *Current Hydro Capacity (2004 Power Plant Database)*
 - *About 10,000 MW (Small + Large)*
 - *1260 MW Small Hydro*
- ◆ *Also ~2600 MW Pumped Storage*



Small Hydro



◆ *Two Resource Assessments*

➤ *Impoundments and Natural Waterways*

➔ *1998 Study by Idaho National Engineering and Environmental Laboratory (INEEL)*

➤ *Man-made Conduits*

➔ *2004 Draft Consultant Report by Navigant Consulting, Inc. (NCI)*



Small Hydro- Impoundments

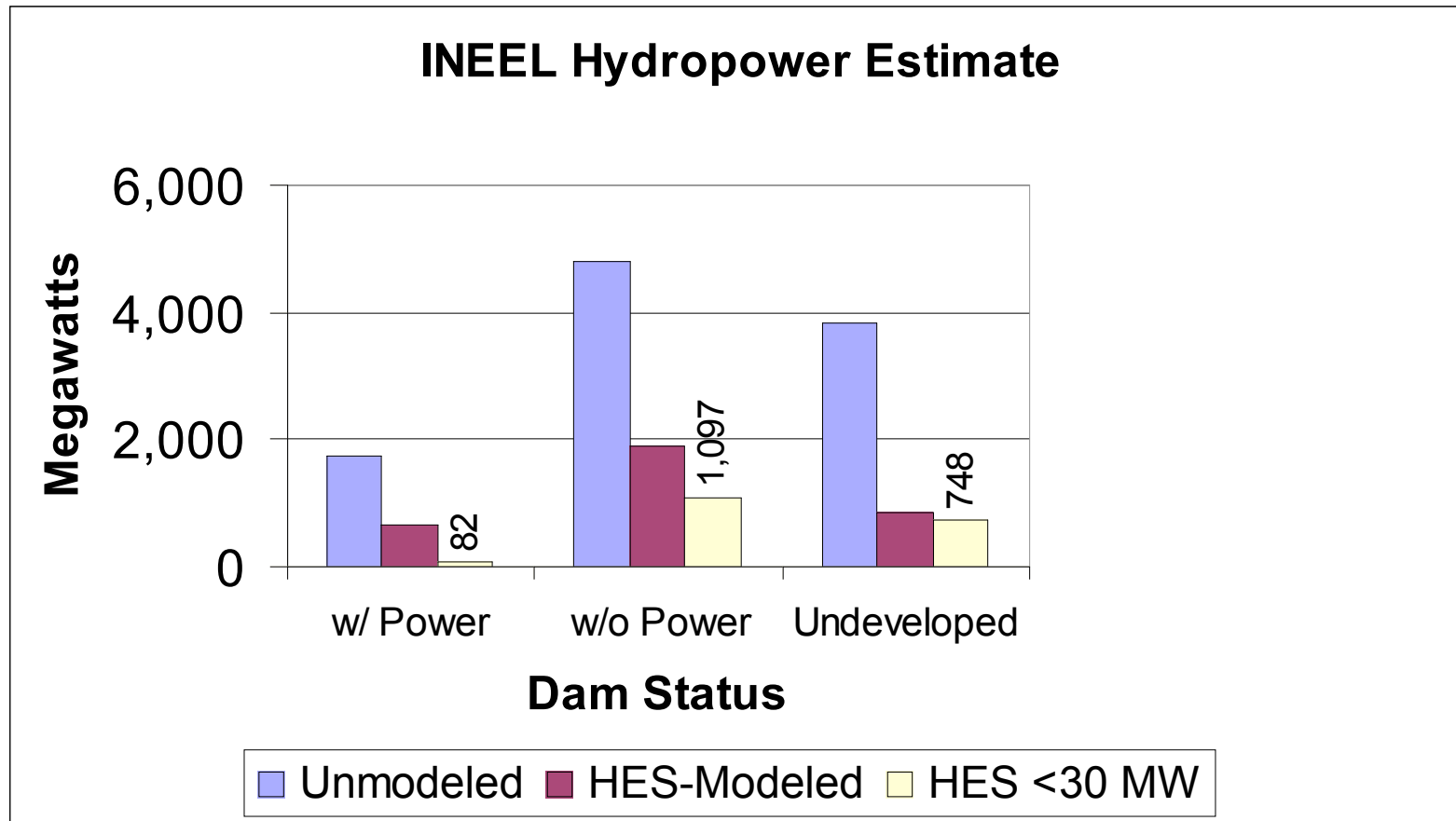


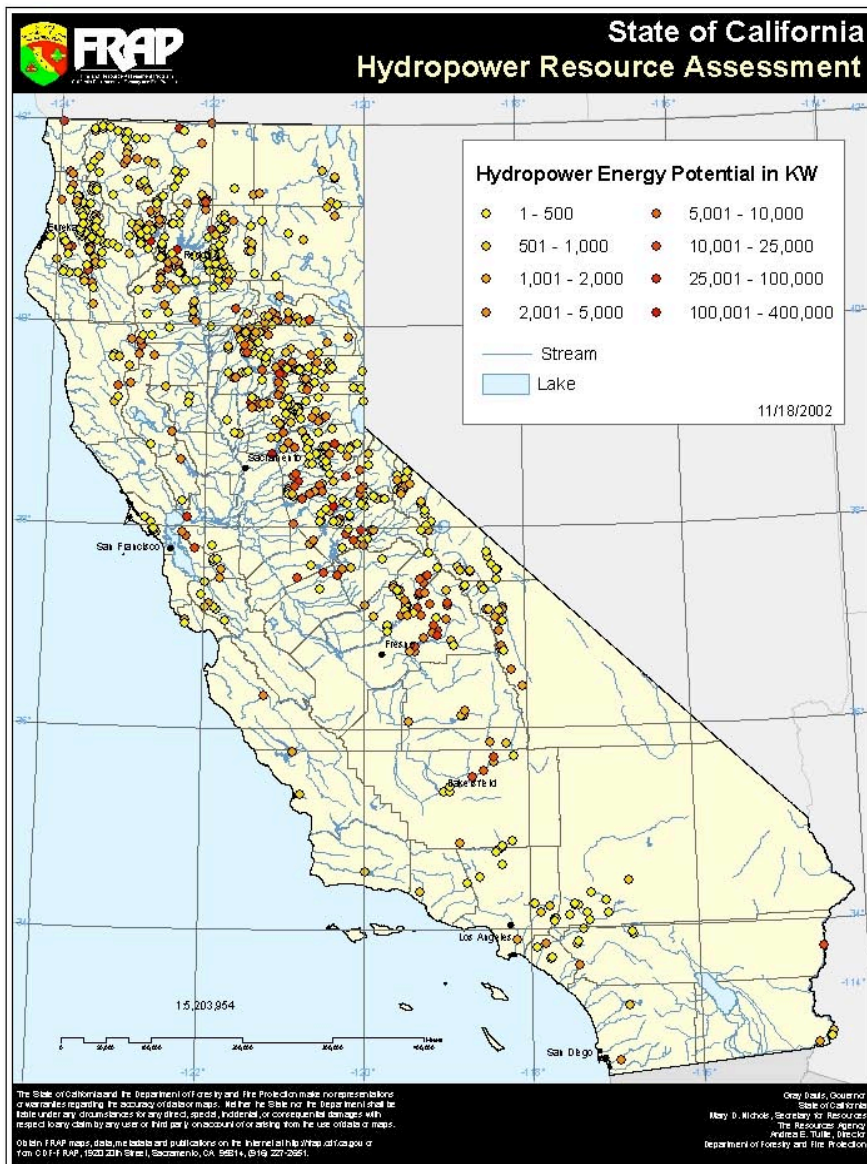
◆ *INEEL*

- *Conventional Generation*
- *Probabilistic Model Based on Environmental Attributes*
- *Weighted Toward Existing/Potential Impoundments and Diversions*
- *Not Strictly a Small Hydro Resource Assessment*



Small Hydro- Impoundments





Results:



◆ *Additional Small Hydro Capacity: 1927 MW*

◆ *Geography*

➤ *No Surprises*

➤ *Top Counties*

➤ *Fresno*

➤ *Shasta*

➤ *Amador*

➤ *Sierra*



Small Hydro- Impoundments



- ◆ *Shortcomings:*

- *“Big Picture” Study*
- *Mostly not RPS or SEP eligible*

- ◆ *What’s Needed? Inventory of RPS-eligible Small Hydro Resources*



Conduit Small Hydro



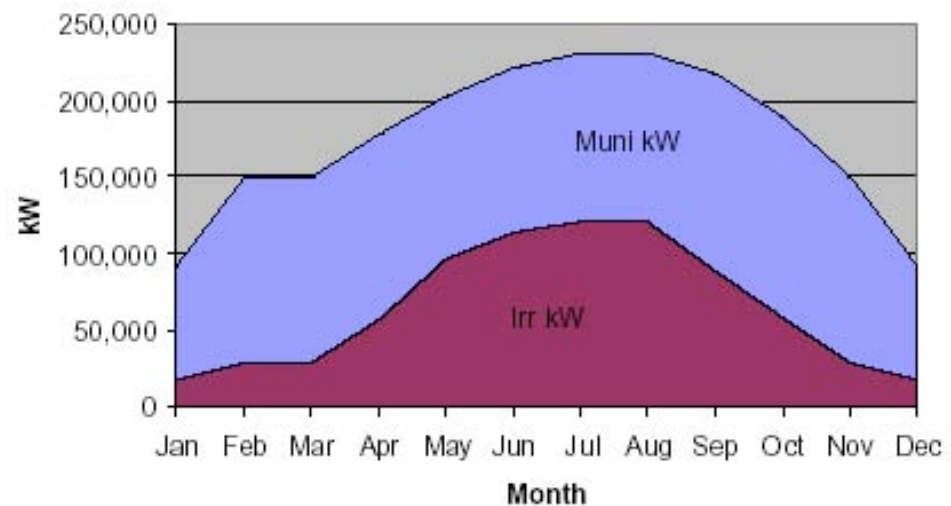
- ◆ *Pipelines and Irrigation Canals*
- ◆ *Hybrid Methodology*
 - *Water Agency Interviews*
 - *Head-Flow Analysis When Available*
 - *Extrapolation to like Agencies*
- ◆ *Does Not Include:*
 - *Re-powering*
 - *Process Wastewater*
 - *Existing Dams*



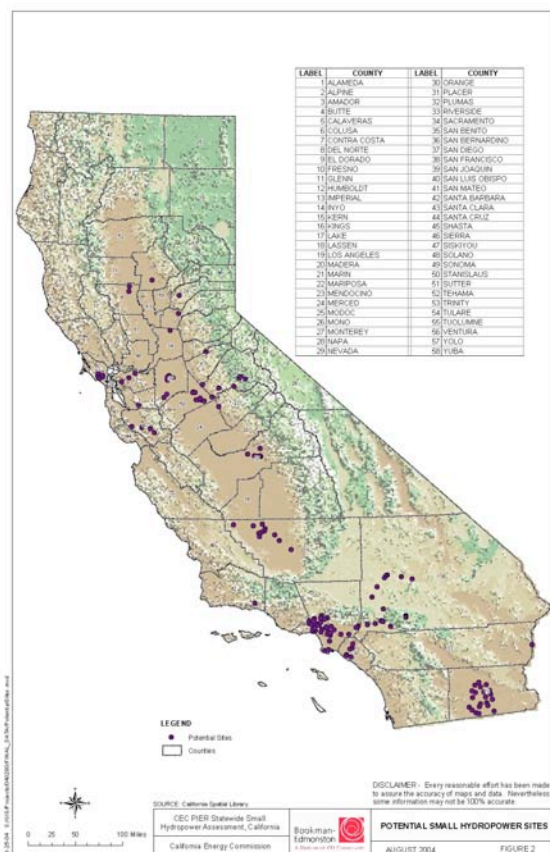
Conduit Small Hydro

Summary of Results

- ◆ **231 Coincident Peak Megawatts**
 - *Evenly Divided Between Irrigation and Municipal*
 - *Coincident Peak In July/ August*
 - *Irrigation Shows Greater Seasonal Variation*
- ◆ **About 255 Nameplate Megawatts**



Conduit Small Hydro



COUNTY	KW	COUNTY	KW
Los Angeles	56,932	Merced	2,883
Stanislaus	29,940	Yuba	2,464
Kern	19,177	Santa Clara	2,058
San Bernardino	17,728	Modoc	1,921
Tulare	12,258	Sacramento	1,506
Imperial	9,539	Shasta	1,452
San Joaquin	7,406	Yolo	1,345
Madera	6,793	Orange	1,189
Fresno	6,426	Monterey	1,153
Solano	5,425	Placer	778
San Diego	4,874	Santa Barbara	761
Glenn	4,292	Siskiyou	500
Kings	4,054	El Dorado	481
Riverside	3,961	San Benito	337
Colusa	3,929	Calaveras	289
Alameda	3,200	Sonoma	269
Contra Costa	3,144	Napa	204
Inyo	3,074	San Luis Obispo	192
Sutter	3,037	Tehama	177
Butte	2,974	Ventura	154
Nevada	2,962		





Ocean Wave Energy Resources



Ocean Wave Resources



- ◆ *Ocean Wave Electricity Generation is Not New*
 - *Early attempts in late 19th Century*
 - *Sporadic Attempts throughout the 20th Century*
 - *Uneconomic*
 - *Insufficiently Robust*
- ◆ *Interest Renewed in Late 1980's in Europe and Elsewhere*
- ◆ *New Technologies Starting Coming On-Line*
- ◆ *Need to Assess California's Ocean Wave Energy Potential*



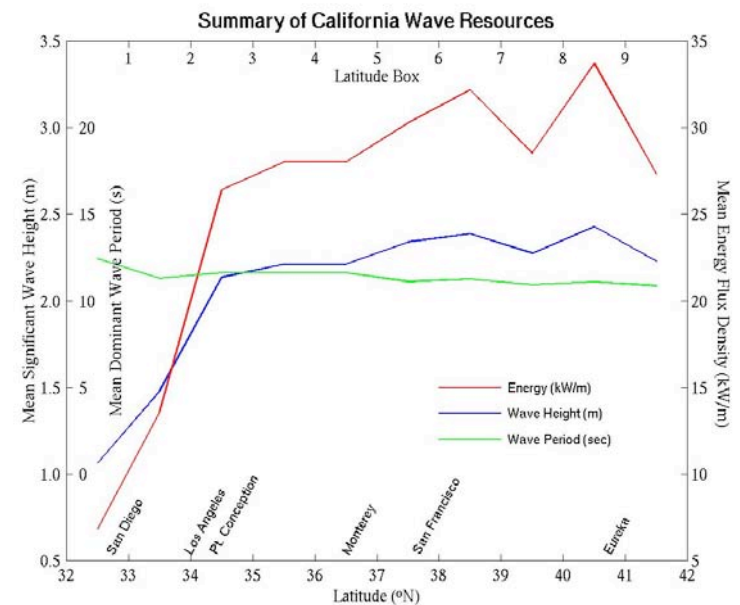
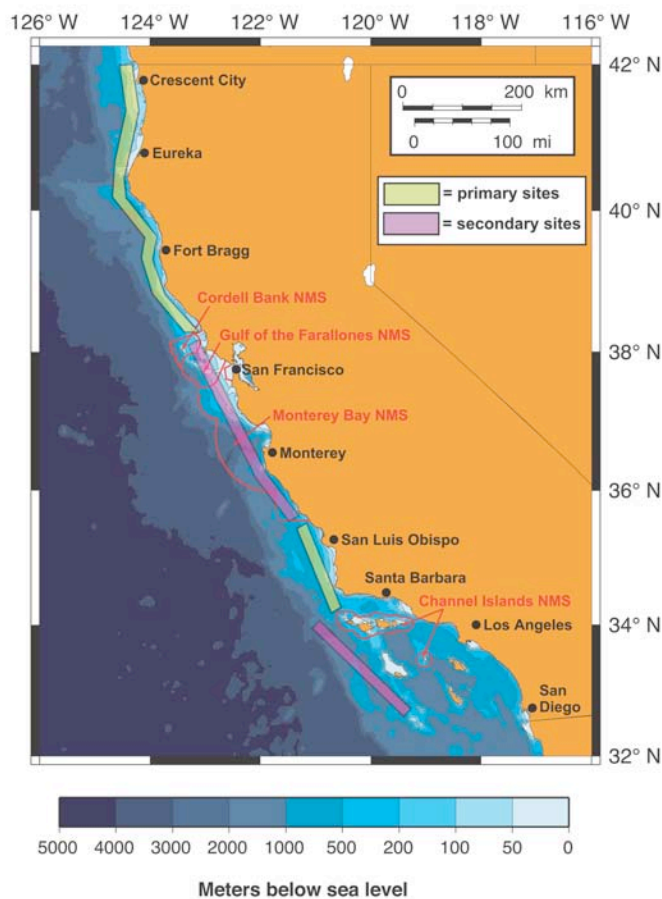
Ocean Wave Resources



- ◆ *SDSU Resource Assessment*
- ◆ *Raw Average Wave Power: 37 GW*
- ◆ *Account for:*
 - *Water-to-wire Efficiency*
 - *Capacity vs. Capacity Factor*
 - *Device Spacing/Competing Uses*
- ◆ *Results:*
 - *7.46 GW*



Ocean Wave Resources



- ◆ **Primary Sites:**
 - High energy
 - Deep Water Near Shore
 - Easier Permitting
- ◆ **Secondary Sites:**
 - Lower energy
 - Further from shore
 - Permitting Difficulties



Conclusions

